

We claim:

1. An apparatus for producing an electron beam, comprising:
  - (a) a support structure;
  - (b) a miniature ultrahigh vacuum chamber comprising a superconducting single walled  
5 metallic-type carbon nanotube comprised of a cylindrical wall, a proximal end disposed upon and sealed to said support structure, and a distal end comprising an electron-transparent structure;
  - (c) an electron beam emitting tip comprising a second carbon nanotube embedded in said support structure and disposed within said superconducting single walled  
10 metallic-type carbon nanotube, said second carbon nanotube having an inner surface with a thin conductive coating disposed thereupon; and
  - (d) means for creating an electrical potential difference between said electron beam emitting tip and said cylindrical wall of said superconducting carbon nanotube.
2. The apparatus as recited in claim 1, wherein said thin conductive coating is selected from  
15 the group consisting of silver, copper, gold, titanium, and mixtures thereof.
3. The apparatus as recited in claim 1, wherein said electron beam emitting tip further comprises an insulating film disposed between said inner surface of said second carbon nanotube and said thin conductive coating.
4. The apparatus as recited in claim 1, wherein said means for creating an electrical potential  
20 difference between said electron beam emitting tip and said cylindrical wall of said superconducting carbon nanotube comprises an electrical lead passing through said support structure to said cylindrical wall of said superconducting carbon nanotube.

5. The apparatus as recited in claim 1, wherein said electron-transparent structure of said distal end of said superconducting single walled metallic-type carbon nanotube comprises a semispherical end cap.
6. The apparatus as recited in claim 1, wherein said second carbon nanotube has a diameter  
5 between 0.3 and 10 nanometers.
7. The apparatus as recited in claim 6, wherein said second carbon nanotube is a single walled metallic type carbon nanotube.
8. The apparatus as recited in claim 6, wherein said second carbon nanotube is a multi-walled metallic type carbon nanotube.
- 10 9. The apparatus as recited in claim 1, wherein said superconducting single walled metallic-type carbon nanotube has a diameter between 5 and 200 nanometers.
10. The apparatus as recited in claim 9, wherein said superconducting single walled metallic-type carbon nanotube has a diameter between 10 and 200 nanometers and said second carbon nanotube has a diameter between 0.3 and 5 nanometers.
- 15 11. The apparatus as recited in claim 1, wherein said superconducting single walled metallic-type carbon nanotube has an aspect ratio of diameter:length of at least about 1:10 to 1:1000.
12. A scanning electron microscope comprising an enclosed point source electron beam generator disposed within a conically tapered enclosure having a proximal end and a distal end, said proximal end in communication through an opening therein with a vacuum tube,  
20 and said distal end comprising a conical pipette tip target opening.
13. The apparatus as recited in claim 12, wherein said enclosed point source electron beam generator comprises a support structure, and a first carbon nanotube disposed upon and sealed to said support structure.

14. The apparatus as recited in claim 13, wherein said enclosed point source electron beam generator further comprises a second carbon nanotube embedded in said support structure and disposed within said first carbon nanotube.

15. The apparatus as recited in claim 14, wherein said second carbon nanotube has a diameter  
5 between 0.3 and 10 nanometers.

16. The apparatus as recited in claim 14, wherein said second carbon nanotube is a single walled metallic type carbon nanotube.

17. The apparatus as recited in claim 14, wherein said second carbon nanotube is a multi-walled metallic type carbon nanotube.

10 18. The apparatus as recited in claim 13, wherein said first carbon nanotube comprises a semispherical end cap.

19. The apparatus as recited in claim 12, wherein said conical pipette tip target opening has a diameter ranging from about 10 nanometers to about 300 nanometers.

20. The apparatus as recited in claim 12, wherein said conical pipette tip target opening is  
15 coated with a watertight sealant.